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Colorectal cancer incidence in the Aboriginal population of Ontario, 1998 to 2009

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and Loraine D. Marrett

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- ... not applicable
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- 0^s value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
- ^p preliminary
- ^r revised
- x suppressed to meet the confidentiality requirements of the *Statistics Act*
- ^E use with caution
- F too unreliable to be published
- * significantly different from reference category ($p < 0.05$)

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Colorectal cancer incidence in the Aboriginal population of Ontario, 1998 to 2009

by Stephanie W. Young, E. Diane Nishri, Elisa Candido and Loraine D. Marrett

Abstract

Background: Studies suggest that colorectal cancer incidence increased disproportionately among the Aboriginal population of Ontario relative to the general population. Using an ecological approach, this study examined colorectal cancer incidence for the 1998-to-2009 period among Aboriginal people living in Ontario.

Data and methods: Based on their postal code at diagnosis, cases of colorectal cancer identified from the Ontario Cancer Registry were assigned to census geographic areas with high (33% or more) or low percentages of Aboriginal identity residents, using the Postal Code Conversion File Plus (PCCF+). To account for potential misclassification by the PCCF+, Indian reserves for which assignment through postal codes is likely to be accurate were identified. Age-standardized incidence rates and rate ratios were calculated to compare colorectal cancer incidence in high-Aboriginal identity areas or on Indian reserves with incidence in low-Aboriginal identity areas.

Results: Colorectal cancer incidence was significantly higher for residents of high- versus low-Aboriginal identity areas in Ontario (rate ratio for men = 1.44, 95% CI = 1.26-1.63; rate ratio for women = 1.42, 95% CI = 1.23-1.63), a disparity that persisted by age group. When the Aboriginal sample was limited to residents of Indian reserves, the difference was statistically significant only for men and for people aged 50 to 74.

Interpretation: The incidence of colorectal cancer differs across areas of Ontario with high and low percentages of Aboriginal identity residents.

Keywords: Data linkage, ecological studies, First Nations health

Colorectal cancer is the third most commonly diagnosed cancer, and the second leading cause of cancer death in Canada.¹ Because Aboriginal identity or ancestry (ethnicity) is not routinely captured in cancer registries and mortality databases, little is known about colorectal cancer morbidity and mortality among Aboriginal people.

A study² of a cohort constructed from the Indian Register noted that colorectal cancer incidence rates rose rapidly among First Nations people in Ontario from 1968 to 1991. As a result, the colorectal cancer incidence rate for First Nations women increased from 29% of the rate for the general population in the 1968-to-1975 period to 78% in the 1984-to-1991 period; the pattern was similar for men. A follow-up³ to this study showed that colorectal cancer incidence rates for Ontario First Nations people continued to rise, and in the 1997-to-2001 period, were converging with those for the general population. These findings, which are based on resource-intensive methods that are not feasible to apply on a routine basis, require updating. Using an ecological approach, the present analysis estimates the incidence of colorectal cancer for the 1998-to-2009 period among the Aboriginal identity population of Ontario and among First Nations people living on Indian reserves in Ontario.

Data and methods

Colorectal cancer cases

Incident cases of colorectal cancer diagnosed in Ontario from 1998 to 2009 were identified from the population-based Ontario Cancer Registry (OCR) operated by Cancer Care Ontario.⁴

Invasive cancers with a primary site of colon or rectum (codes C18, C19, C20, and C26.0 in the *International Classification of Diseases for Oncology 3rd edition*) were extracted from the OCR.⁵ Cancers of the anus, anal canal and anorectum were excluded, as were hematopoietic malignancies, mesotheliomas and Kaposi sarcomas. Statistics Canada's Postal Code Conversion File Plus (PCCF+) was used to assign census geographic identifiers, including Dissemination Area (DA), Census Subdivision (CSD) and CSD type, to each case, based on postal code of residence at diagnosis.⁶ PCCF+ version 5K is derived from 2006 Census geography and was used to assign a DA and CSD to cases diagnosed from 2004 to 2009; version 4J, derived from 2001 Census geography, was used for cases diagnosed from 1998 to 2003.

Residence in high-Aboriginal identity area

Population attributes of each DA in Ontario, such as size and percentage of Aboriginal identity residents, were retrieved for the 2001 and 2006 Censuses. The DA is the smallest standard geographic area (population 400 to 700) for which census data are published.⁷

"High-Aboriginal identity areas" were defined as DAs where 33% or more of the population self-identified as Aboriginal or as incompletely enumerated DAs contained within known Indian reserves; all other DAs were designated "low-Aboriginal identity areas."⁸⁻¹¹ Each high-Aboriginal identity area was further classified by the predominant Aboriginal identity group (First Nations people, Métis or Inuit) in that area.

Colorectal cancer cases were designated as living in a high- or low-Aboriginal identity area, based on their DA of residence

at diagnosis and the nearest census year. If no Aboriginal indicator value could be assigned to a DA for one census year, the value in the other census year was assigned, based on the assumption that the percentage of Aboriginal people in the DA was unlikely to change substantially between the 2001 and 2006 Censuses.

Residence on Indian reserve

Assignment of census geographic identifiers using postal codes can result in misclassification, particularly in rural areas where postal codes often span more than one DA or CSD. In such instances, the PCCF+ uses a population-weighted random allocation algorithm,⁶ which increases the likelihood that individuals will be incorrectly assigned to a geographic area that may have different attributes than the one in which they actually reside. Because many high-Aboriginal identity areas are rural, this is a potentially important issue. Therefore, a sensitivity analysis was conducted using only cases with a high probability of residing on an Indian reserve (and were, therefore, less likely to be misclassified). This restricted group comprised cases living on reserves covered by one or more postal codes, each of which mapped to the reserve with a probability of 0.90 or greater. These reserves were identified separately for 2001 and 2006 Census geography from the CSD type. The postal codes corresponding directly to these reserves and their associated population weights were identified from PCCF+ v5K for 2006 Census geography and from PCCF+ v4J for 2001 Census geography.

Population estimates

Population estimates were obtained at the DA level for the 2001 and 2006 Censuses. Estimates for incompletely enumerated Indian reserves were imputed based on data from the Indian Register. For non-census years, population data for the nearest census year were used; intercensal estimates are not available at the DA level.

Statistical analysis

Colorectal cancer frequencies and direct age-standardized incidence rates (ASIRs) were calculated using SEER*Stat version 8.1.2.¹² Analyses were performed for high- and low-Aboriginal identity areas and for the restricted case group living on Indian reserves. Analyses were stratified by sex and age group (younger than 50, 50 to 74, and 75 or older), and for colon and rectal cancers. Rates were age-standardized to the 1991 Canadian population using five-year groupings and expressed per 100,000 population. Rate ratios and 95% confidence intervals were calculated to compare colorectal cancer incidence in high-Aboriginal identity areas or on Indian reserves with incidence in low-Aboriginal identity areas.

Results

High- versus low-Aboriginal identity areas

Based on 2001 Census data, 294 of Ontario's 18,596 DAs were classified as "high-Aboriginal identity"; based on 2006 Census data, 307 of Ontario's 19,177 DAs were so classified. In both years, high-Aboriginal identity DAs represented 1.6% of all DAs, and the

population of high-Aboriginal identity areas represented 0.6% of the total population. The predominant Aboriginal identity group was First Nations in the vast majority of these DAs; only seven had a predominant Aboriginal identity of Métis, and none were predominantly Inuit. Of the 307 DAs classified as high-Aboriginal identity in 2006, 278 (91%) were within an Indian reserve (Appendix); in 2001, 252 (86%) of the 294 high-Aboriginal identity DAs were within an Indian reserve. The difference between 2001 and 2006 in the total number of high-Aboriginal identity DAs and the number within Indian reserves is due to changes in DA boundaries between the two census years.

In 2006, people in high-Aboriginal identity areas were younger and less educated, had a lower average household income, a higher unemployment rate, and a greater percentage of lone-parent families, compared with people in the low-Aboriginal identity areas (Table 1). Similar differences between the low- and high-Aboriginal identity areas were observed in 2001.

Of colorectal cancer cases diagnosed from 1998 to 2009, 478 were assigned to high-Aboriginal identity areas, and 83,679, to low-Aboriginal identity

Table 1
Selected socio-demographic characteristics of Ontario population, by area of residence, 2006

Population characteristics	Area of residence	
	Low-Aboriginal identity	High-Aboriginal identity
Population younger than 15 (%)	18.1	29.0
Population 65 or older (%)	13.6	7.2
Average household income (\$)	76,794	40,777
Receiving government transfer payments (%)	9.9	23.0
Low income before tax (%)	14.4	21.0
Occupied private dwellings in need of major repairs (%)	6.3	30.1
Lone-parent families* (%)	24.3	42.1
Less than high school graduation† (%)	18.5	43.1
University degree or more‡ (%)	23.1	5.7
Unemployed§ (%)	6.3	16.6
Professional occupation¶ (%)	17.6	12.1

* as percentage of all families with children

† as percentage of population aged 25 or older

‡ as percentage of population aged 15 or older in labour force

§ senior management; professional occupations in business and finance, natural and applied sciences, health, and art and culture; nurse supervisors and registered nurses; judges, lawyers, psychologists, social workers, ministers of religion, and policy and program officers; teachers and professors

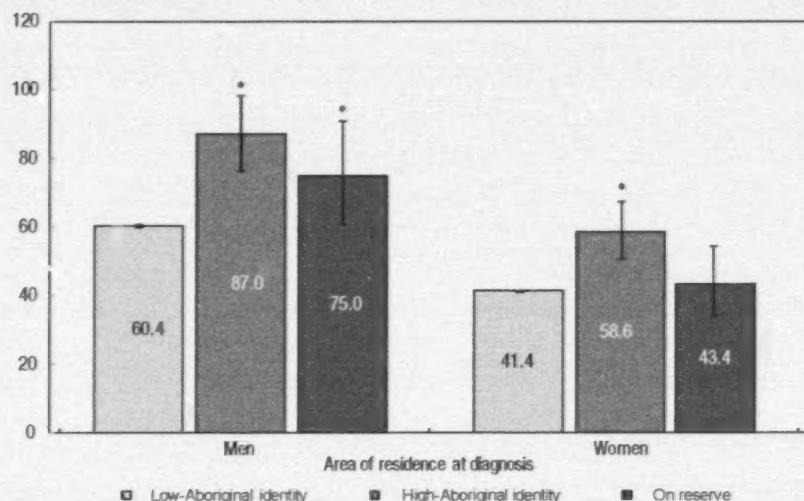
Source: Statistics Canada. Profile for Canada, Provinces, Territories, Census Divisions, Census Subdivisions and Dissemination Areas, 2006 Census (Catalogue 94-581-XCB2006002) Ottawa: Statistics Canada, 2008.

areas, corresponding to ASIRs of 71.5 and 50.1 cases per 100,000 population, respectively (rate ratio [RR] = 1.43, 95% CI = 1.30-1.56). Because of missing or

invalid postal codes, 1,675 cases (2%) could not be assigned to a high- or low-Aboriginal identity DA.

Figure 1
Age-standardized incidence rates (ASIRs) of colorectal cancer, by sex and area of residence at diagnosis, 1998 to 2009

ASIR per 100,000 population



* significantly different from low-Aboriginal identity areas ($p < 0.05$)

Note: Rates are standardized to age distribution of 1991 Canadian population.

Sources: Ontario Cancer Registry 2012 (Cancer Care Ontario); 2001 Census of Canada; 2006 Census of Canada.

Table 2
Age-standardized incidence rates (ASIRs) and rate ratios of colorectal cancer, by age group and area of residence at diagnosis, Ontario, 1998 to 2009

Age group and area of residence at diagnosis	Number of cases	ASIR per 100,000	95% confidence interval		Rate ratio	95% confidence interval	
			from	to		from	to
Younger than 50							
Low-Aboriginal identity [†]	6,285	5.3	5.2	5.5	1.00	...	...
High-Aboriginal identity	48	7.6*	5.6	10.1	1.43*	1.05	1.90
On reserve	22	6.5	4.0	9.8	1.21	0.76	1.83
50 to 74							
Low-Aboriginal identity [†]	46,350	144.3	143.0	145.7	1.00	...	...
High-Aboriginal identity	303	211.6*	188.1	237.1	1.47*	1.30	1.64
On reserve	133	174.3*	145.6	207.0	1.21*	1.01	1.43
75 or older							
Low-Aboriginal identity [†]	31,044	366.9	362.8	371.0	1.00	...	...
High-Aboriginal identity	127	500.4*	416.9	595.7	1.36*	1.14	1.62
On reserve	44	368.3	266.9	495.9	1.00	0.73	1.35
Total							
Low-Aboriginal identity [†]	83,679	50.1	49.7	50.4	1.00	...	...
High-Aboriginal identity	478	71.5*	65.1	78.3	1.43*	1.30	1.56
On reserve	199	57.0	49.2	65.7	1.14	0.98	1.31

[†] reference group

* significantly different from reference group ($p < 0.05$)

... not applicable

Note: Rates are standardized to age distribution of 1991 Canadian population.

Source: Ontario Cancer Registry 2012 (Cancer Care Ontario); 2001 Census of Canada; 2006 Census of Canada.

Colorectal cancer incidence was significantly higher in high- versus low-Aboriginal identity areas for both sexes (RR for men = 1.44, 95% CI = 1.26-1.63; RR for women = 1.42, 95% CI = 1.23-1.63) (Figure 1). This difference persisted for the three age groups examined (Table 2) and for colon and rectal cancers separately (Table 3).

On-reserve versus low-Aboriginal identity areas

Of the 478 colorectal cancer cases diagnosed among residents of high-Aboriginal identity areas between 1998 and 2009, 199 had a high probability of residing on an Indian reserve. Although incidence rates of colorectal cancer were higher among people living on reserves compared with residents of low-Aboriginal identity areas, the difference was not statistically significant (RR = 1.14, 95% CI = 0.98-1.31). Colorectal cancer incidence was significantly higher among residents of reserves compared with low-Aboriginal area residents for men but not for women (RR for men = 1.24, 95% CI = 1.01-1.50; RR for women = 1.05, 95% CI = 0.83-1.31) (Figure 1). The only age group for which the difference was statistically significant was 50 to 74 (Table 2). No statistically significant differences were observed by cancer subsite (Table 3).

Discussion

During the 1998-to-2009 period, colorectal cancer incidence rates in Ontario were significantly higher among residents of high-Aboriginal identity areas compared with low-Aboriginal identity areas. This difference prevailed among men and women, for all age groups, and for colon and rectal cancers. Incidence rates were also higher among people with a high probability of residing on Indian reserves, compared with people living in low-Aboriginal identity areas, but the difference was statistically significant only for men and for 50- to 74-year-olds.

The excess risk of colorectal cancer observed in this analysis is consistent with the results of previous research. A

Table 3

Age-standardized incidence rates (ASIRs) and rate ratios of colorectal cancer, by subsite and area of residence at diagnosis, Ontario, 1998 to 2009

Subsite and area of residence at diagnosis	Number of cases	ASIR per 100,000	95% confidence interval		Rate ratio	95% confidence interval	
			from	to		from	to
Colon							
Low-Aboriginal identity†	56,312	33.6	33.3	33.9	1.00	...	...
High-Aboriginal identity	307	46.5*	41.4	52.1	1.38*	1.23	1.55
On reserve	136	39.4	32.9	46.7	1.17	0.98	1.39
Rectum							
Low-Aboriginal identity†	27,367	16.4	16.2	16.6	1.00	...	...
High-Aboriginal identity	171	25.0*	21.3	29.1	1.52*	1.30	1.77
On reserve	63	17.7	13.4	22.7	1.07	0.82	1.38

[†] reference group

* significantly different from reference group ($p < 0.05$)

... not applicable

Note: Rates are standardized to age distribution of 1991 Canadian population.

Source: Ontario Cancer Registry 2012 (Cancer Care Ontario); 2001 Census of Canada; 2006 Census of Canada.

much earlier study found lower rates of colorectal cancer among First Nations people in Ontario,² but an update of that research showed that incidence rates were rising rapidly and converging with those of the general population during the 1997-to-2001 period.³ Specifically, colorectal cancer incidence rates of First Nations men had surpassed those of men in the general population, although the difference was not significant. Colorectal cancer incidence rates of First Nations women were approaching those of women in the general population. These findings may explain why, in the present study, the difference between the residents of Indian reserves and people living in low-Aboriginal identity areas was significant for men, but not for women.

A more recent analysis showed similar incidence rates of colorectal cancer among Aboriginal people living on reserves in Quebec and the general population.¹³ A study of Inuit living in the Arctic reported higher incidence rates, compared with the non-Inuit population in the same region.¹⁴

Similar patterns in colorectal cancer have been observed in Aboriginal populations in other countries. A study of American Indians and Alaska Natives found higher incidence rates, compared with the white population.¹⁵ These rates and rate ratios varied widely by geographic location, which may reflect differences in screening and risk

factors.^{15,16} As well, in New Zealand, colon cancer incidence rates increased significantly over two decades among the indigenous Māori population, but remained stable among other ethnic groups.¹⁷

The differences in colorectal cancer incidence between high- and low-Aboriginal identity areas in Ontario may reflect differences in the distribution of risk factors. Aboriginal people have shifted away from traditional foods toward diets high in fat and sugar; this transition, combined with a more sedentary lifestyle, has increased the prevalence of risk factors for colorectal cancer.¹⁸ The percentage of the population who are obese or overweight, which reflects greater caloric intake and reduced physical activity, is higher among the Aboriginal population living off reserves, compared with the non-Aboriginal population in Ontario.¹⁹ As well, the prevalence of other risk factors for colorectal cancer, including smoking, alcohol consumption and physical inactivity, is high among the Ontario First Nations population who live on reserves.²⁰

Disparities in screening between the high- and low-Aboriginal identity areas may also contribute to some of the observed differences in colorectal cancer incidence. A Cancer Care Ontario survey of several Aboriginal communities found that two-thirds of the participants had little to no knowledge of colorectal cancer screening methods.²¹

Socio-economic disparities between the two populations may be related to the excess risk of colorectal cancer in high-Aboriginal identity areas. Residents of high- and low-Aboriginal identity areas differed substantially by education, employment and income, with the population of high-Aboriginal identity areas experiencing lower overall socio-economic

What is already known on this subject?

- Colorectal cancer is the third most commonly diagnosed cancer and the second leading cause of cancer death in Canada.
- Studies suggest that colorectal cancer incidence is increasing more rapidly in the Aboriginal population than in the general population.
- The incidence of colorectal cancer among Aboriginal people in Ontario cannot be routinely monitored because the Ontario Cancer Registry does not collect information on Aboriginal identity or ethnicity.

What does this study add?

- Colorectal cancer incidence was significantly higher in areas of Ontario with a high percentage (33% or more) of residents who self-identified as being an Aboriginal person, compared with areas with a low percentage of Aboriginal identity residents.
- To account for potential misclassification by PCCF+'s population-weighted random assignment, Indian reserves, for which the accuracy of case assignment through postal codes is high, were used to examine health outcomes for a subgroup of First Nations people.
- Although colorectal cancer incidence among residents of reserves was lower than among residents of high-Aboriginal identity areas, rates for men and for people aged 50 to 74 were significantly higher compared with those in low-Aboriginal identity areas.

nostic status. Lower socio-economic status groups in Canada, the United States, Europe, and Australia have been found to have a higher incidence of colorectal cancer, as well as shorter survival, and higher mortality.²²⁻²⁶

Limitations

This analysis has several limitations. First, the number of colorectal cancer cases assigned to high-Aboriginal identity areas was too small to examine trends over time.

Second, the use of area-level data to assign cases to high-Aboriginal identity areas does not necessarily correspond to an individual's identity. Nonetheless, studies using area-based socio-demographic indicators have shown them to be valid for assessing health inequalities.^{27,28} Additionally, the sensitivity analysis attempts to minimize bias due to misclassification of individuals' Aboriginal identity by examining cases with a high probability of residing on an Indian reserve, and therefore, of being identified as an Aboriginal person (First Nations).

Third, the area-level indicator in this study is sensitive only to moderately or highly concentrated Aboriginal identity populations. The predominant Aboriginal

identity group in nearly all the high-Aboriginal identity areas is First Nations, who comprise the majority of residents on Indian reserves.^{29,30} Therefore, the findings of this study are generalizable to the on-reserve First Nations population, but less so to the Métis and off-reserve Aboriginal population.

Finally, some of the disparity between colorectal cancer incidence in high- and low-Aboriginal identity areas may be due to differences in the age distributions of the respective populations. The population weights used by PCCF+ are based on the total population. PCCF+ may work best for the middle-age group and less well for the older and younger age groups, for which the difference between the on-reserve First Nations and total populations is greater. This may explain why the disparity in incidence rates remained for the 50 to 74 age group when the sample was limited to the subset of Indian reserves.

Conclusion

In the absence of individual-level information on Aboriginal identity or ancestry (ethnicity) in the Ontario Cancer Registry, area-level analyses can be used,

but caution should be exercised. Because of differences in the age distributions of the on-reserve First Nations population and the total population, it is likely that the use of high-Aboriginal identity areas with cancer data that have been assigned geographically with PCCF+ will introduce bias. Differences were apparent in colorectal cancer incidence between high-Aboriginal identity areas and the subset of Indian reserves, for which the accuracy of case assignment based on postal codes is high. Although colorectal cancer incidence among residents of Indian reserves was lower than among residents of high-Aboriginal identity areas, it was still significantly higher for men and for people aged 50 to 74 in low-Aboriginal identity areas. Together with evidence from previous studies, these findings suggest that colorectal cancer has emerged as a health disparity for the on-reserve First Nations people in Ontario. ■

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Appendix

2006 Aboriginal population, by Dissemination Area, Ontario

